## REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, claim 12 has been amended to recite that the apparatus is for etching a surface of a sample using a plasma; to recite that the inclined side wall member includes an electrically non-conductive member facing the plasma; to recite that the Faraday shield is disposed in a floating position to a ground while the plasma is generated for etching the surface of the sample; to recite that the sample stage is disposed below the plasma generating portion inside the vacuum chamber; and to recite that the discharge unit, for discharging the gas from a space around the sample stage of the vacuum chamber, includes a discharge outlet from the vacuum chamber, positioned such that there is disposed a path, for discharging the gas, along an inside of the inclined side wall member. Note, for example, pages 25-27 of Applicants' specification.

Moreover, Applicants are adding new claims 19-21 to the application. Claim 19, dependent on claim 12, recites that the discharge outlet is positioned below the inclined side wall member; and claims 20 and 21, dependent respectively on claims 19 and 12, recite that the discharge outlet is located at a side of the plasma processing apparatus. See, e.g., among other drawing figures, Fig. 16.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed November 25, 2003, that is, the teachings of the U.S. Patents to Collins, et al., No. 5,556,501, to Lu, et al., No. 5,904,778, to Li, et al., No. 5,772,771, to

Savas, et al., No. 5,811,022, to Gorin, No. 4,464,223, and to Schneider, et al., No. 6,308,654, under the provisions of 35 USC §103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a plasma processing apparatus for etching a surface of a sample as recited in the present claims, having, inter alia, a vacuum chamber with an inclined side wall member, the inclined side wall member comprising an electrically non-conductive member facing the plasma, and having a Faraday shield and coil antenna as in the present claims, with a sample stage disposed below the plasma generating portion inside the vacuum chamber, and with a discharge unit disposed below the sample stage for discharging the gas from a space around the sample stage out of the vacuum chamber, the discharge unit including a discharge outlet from the vacuum chamber, positioned such that there is disposed a path, for discharging the gas, along an inside of the inclined side wall member. See claim 12.

Moreover, it is respectfully submitted that these references would have neither disclosed nor would have suggested such plasma processing apparatus as discussed in connection with claim 12, and, furthermore, wherein the discharge outlet is positioned below the inclined side wall member (see claim 19); and/or wherein the discharge outlet is at a side of the plasma processing apparatus (see claims 20 and 21).

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a plasma processing apparatus as in the present claims, having features as discussed

previously in connection with claim 12, and, moreover, wherein a plate made of a conductor or a semiconductor is provided, placed on an inner side of the upper face of the vacuum chamber (see claim 13), particularly wherein a radio-frequency power source is applied to the plate (see claim 14), or a DC voltage source is applied to the plate (see claim 15), or wherein the plate is grounded (see claim 16); and/or the radius of the lower face of the trapezoidal form of the vacuum chamber relative to a height from the sample stage to the upper face of the chamber, as in claim 17; and/or the relation of the radius of the upper face of the vacuum chamber, lower face thereof and height from the sample stage to the upper face, as in claim 18.

The invention as claimed in the above-identified application is directed to a plasma processing apparatus for etching the surface of a substrate, utilizing a plasma generated in a plasma generating portion of a vacuum chamber.

As one of the problems in connection with such apparatus, impurities and contaminants, e.g., generated from the inner wall surface and/or along the inner wall of the vacuum chamber, can damage the sample being etched. These contaminants (for example, foreign matters or reaction products generated just inside the side wall) are apt to move toward the sample and be deposited thereon, having a bad effect on the etched sample. As can be appreciated, this problem is particularly serious where the side wall is inclined inwardly, relative to the vertical, of the vacuum chamber, whereby a projection of the side wall falls closer to the sample/sample stage. Moreover, this problem is even worse with respect to plasma processing apparatus in which a coil antenna for generating an electric field in the plasma generating portion is wound around the inclined side wall member, outside of

a Faraday shield, the Faraday shield being disposed in a floating position to ground while the plasma is generated for etching the surface of the sample.

Against this background, Applicants provide structure wherein problems due to foreign matters and other contaminants, including reaction products, formed in the vicinity of the inner surface of the inclined side wall member of the vacuum processing chamber, can be avoided. Applicants have found that by utilizing a gas discharge structure according to the present claims, the problem in connection with foreign matters as discussed previously can be avoided. Specifically, by utilizing a discharge unit disposed below the sample stage, with the discharge unit including a discharge outlet from the vacuum chamber, positioned such that there is disposed a path, for discharging the gas, along an inside of the inclined side wall member, the foreign matters and other contaminants generated in the vicinity of the side wall are apt to move along an inside of the inclined side wall member and around the sample stage, avoiding contamination of the sample on the sample stage. Thus, according to the structure of the present invention, the contaminants are inhibited from moving toward the sample inside the chamber, thereby to achieve the advantageous effect of satisfactory processing without contaminants being deposited on the sample being etched. Note, in particular, the paragraph bridging pages 25-27 of Applicants' specification.

Collins, et al. discloses RF plasma processing reactors, using a radio frequency (RF) energy source and a multiple coil antenna for inductively coupling the associated RF electromagnetic wave to the plasma. In one aspect, this patent discloses an RF plasma processing system as described in column 3, lines 42-54.

In another aspect, the system includes a dielectric dome or cylinder, and preferably a coil antenna surrounds the dome for inductively coupling high frequency electromagnetic energy into the chamber. See column 4, lines 12-19. In another aspect, the chamber is evacuated by a first vacuum pump means connected to the chamber proper and a second vacuum pump means connected to the dome for establishing a vertical pressure differential across the dome for establishing a flow of uncharged ions out of the dome. Note the paragraph bridging columns 4 and 5 of this patent. See also Fig. 1 and the description in connection therewith in column 7, lines 40-45, disclosing that evacuation of the interior of the chamber housing 11 is controlled by a throttle valve 18 in a vacuum line 19 which is connected to the bottom wall 14 and connects to a vacuum pumping system 21 comprising one or more vacuum pumps. See also column 8, lines 15-43.

It is respectfully submitted that this patent does not disclose, nor would have suggested, the side wall member structure together with other structures of the vacuum chamber, with the sample stage and discharge unit, and with the other components of the apparatus as set forth in claim 12, and advantages achieved by the present invention, or other aspects of the present invention as in claims other than claim 12.

In particular, attention is respectfully directed to Fig. 1 of Collins, et al., and especially vacuum line 19 connected to the bottom wall 14, and spaced from the side wall 12 of the chamber. It is respectfully submitted that Collins, et al., would have taught away from the present invention, including the location of the discharge unit providing the path as in the present claims.

It is respectfully submitted that the secondary references applied together with Collins, et al., that is, Schneider, et al. and Savas, et al. would not have rectified the deficiencies of Collins, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Schneider, et al. discloses a plasma reaction chamber particularly suited for fabrication of semiconductor integrated circuits and especially so for oxide etching, including a chamber wall in the form of a truncated conically shaped dome positioned over and around the wafer; the outside cone surface of the chamber wall in one embodiment mates with an inside sloped surface of a surrounding thermal control ring. Note column 7, lines 11-25. This thermal ring can contain heating, cooling or electrical field inducing elements; and an inductive coil to create RF magnetic and hence the electrical field that induces the plasma in the chamber is wrapped horizontally around a heater element, the coil conductors thereby being in a direction that is substantially perpendicular to the direction of the predominant routing of the wires of the heating element in the heater. The perpendicularly crossing wires create a Faraday shield to shield the chamber from the capacitive effects of the inductive coil, while allowing the electrical field to be efficiently induced in the plasma. Note column 7, lines 44-64.

Savas, et al. discloses plasma reactors and processes typically used for wafer processing or the like, wherein, in a first embodiment, a plasma reactor is disclosed, having a nonconductive chamber wall that is encircled by an induction coil that is connected to a low frequency RF source. A split Faraday shield is positioned between the induction coil and the sidewall of the reactor and encircles the reactor

to substantially eliminate the conduction of displacement currents between the induction coil and the plasma reactor. See column 7, lines 9-33. See also column 5, lines 8-13. Referring to Fig. 6 of this patent, this patent discloses an exhaust port 58 that is part of an exhaust system 59 that includes a pump to exhaust plasma process products and to keep the pressure to a selected level. See column 15, lines 10-13. Note also column 20, line 57 to column 21, line 10, in connection with Fig. 12.

Even assuming, arguendo, that the teachings of Schneider, et al. and of Savas, et al. were properly combinable with the teachings of Collins, et al., such combined teachings would have neither disclosed nor would have suggested the presently claimed structure, including the discharge unit providing the path as in the present claims, and advantages thereof as discussed in the foregoing.

It is respectfully submitted that the additional teachings of Gorin would not have rectified the deficiencies of the teachings of the previously discussed references, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Gorin discloses a multiple frequency plasma reactor apparatus, including at least three electrodes, one of the electrodes being held at ground while the second is selectively coupled to a high frequency AC source and the third is selectively coupled to a low frequency AC source. See column 1, lines 50-59. Referring to Fig. 2 of this patent, a gas outlet 24 provides for the egress of reaction products from the reaction volume under the influence of a vacuum pump. Note column 2, lines 45-57. Even assuming, arguendo, that the teachings of Gorin were properly

combinable with the teachings of Collins, et al., Schneider, et al., and Savas, et al., such combined teachings would have neither disclosed nor would have suggested the presently claimed apparatus, including the discharge unit. The combined teachings of these applied references would not have disclosed or suggested that the apparatus with the vacuum chamber having the inclined side wall member chamber, with the antenna and Faraday shield, has more egregious problems in connection with contaminants and foreign matters, as well as reaction products, at the side wall falling on and contaminating the sample being etched, and that such severe problems can still be avoided through, in combination with the other structure of the present claims, the discharge unit with the path as in the present claims.

Li, et al. discloses a deposition chamber including a housing defining a vacuum chamber, a substrate support housed within the vacuum chamber, a plurality (typically 12) of first gas distributors having their orifices or other exits opening into the vacuum chamber in a circumferential pattern spaced apart from and generally overlying the circumferential periphery of the substrate support surface, and a second gas distributor spaced apart from and generally overlying the center of the substrate support surface. See column 2, lines 20-33. Note also Fig. 1 and the discussion in connection therewith at column 3, lines 46 and 47, describing vacuum chamber 18 exhausted through an exhaust port 44.

As can be appreciated from Fig. 1 of Li, et al., the exhaust port 44 is spaced from the side of the apparatus, at the bottom of the deposition chamber (relatively close to the substrate support). It is respectfully submitted that Li, et al., even together with the teachings of each of Collins, et al., Schneider, et al. and

Savas, et al., previously discussed, as applied by the Examiner, would have neither taught nor would have suggested the structure according to the present invention, including the inclined side wall member and discharge unit, particularly location of the outlet of the discharge unit providing the path along the inclined side wall member as in the present invention, and advantages thereof. Noting especially the teachings of Li, et al. and of Collins, et al., in connection with location of the exhaust from the vacuum chamber, it is respectfully submitted that the applied prior art would have taught away from the presently claimed invention, and advantages thereof.

Moreover, it is noted that Li, et al., is concerned with deposition equipment, for improved deposition thickness uniformity. It is respectfully submitted that the teachings of this patent would not have contributed any teachings with respect to apparatus as in the present invention, which is apparatus for etching a surface of a sample.

Even including the additional teachings of Gorin, discussed previously, together with the teachings of Li, et al., Collins, et al., Schneider, et al. and Savas, et al., such combined teachings would have neither disclosed nor would have suggested the presently claimed invention, including, inter alia, the side wall member that is inclined and use of the antenna and Faraday shield, with the sample table, and with the discharge unit as in the present claims, providing the path along the inclined side wall member and achieving advantages as discussed previously.

Lu, et al. discloses a silicon carbide composite structure having layers formed by bulk and thin-film methods, these structures being particularly useful in plasma reactors used in fabricating semiconductor devices. See column 4, lines 48-54.

See also Fig. 2 and the corresponding description in connection therewith at column 5, lines 38-44. See also Figs. 8 and 9, showing a conical dome 70 (see Fig. 8) having an RF inductive coil 72 wrapped around its outside.

Collins, et al., Schneider, et al. and Savas, et al. have been previously discussed.

Even assuming, arguendo, that the teachings of Lu, et al. were properly combinable with the teachings of Collins, et al., Schneider, et al. and Savas, et al., such combined teachings would have neither disclosed nor would have suggested the presently claimed invention, including, inter alia, the discharge unit providing the path along the inclined side wall member, and other aspects of the discharge unit, as in the present claims, and advantages thereof, as discussed previously.

In connection with the teachings of Lu, et al., Collins, et al., Schneider, et al. and Savas, et al., it is respectfully submitted that the additional teachings of Gorin would not have taught or suggested the presently claimed invention, including, in combination with the other components, the discharge unit, as discussed previously.

Furthermore, with respect to claims 12, 17 and 18, it is respectfully submitted that the combined teachings of Lu, et al. and Savas, et al. would have neither disclosed nor would have suggested the presently claimed subject matter; with respect to claims 13, 14 and 16, it is respectfully submitted that the combined teachings of Lu, et al., Savas, et al. and Collins, et al. would have neither disclosed nor would have suggested the claimed subject matter; and in connection with claim 15, it is respectfully submitted that the combined teachings of Lu, et al.,

Savas, et al., Collins, et al. and Gorin would have neither taught nor would have suggested the presently claimed subject matter. The individual teachings of each these references have previously been discussed. Even as combined by the Examiner, the teachings of these references would have neither disclosed nor would have suggested the presently claimed apparatus, having the various components including the inclined side wall member and antenna and Faraday shield, with the sample table and with the discharge unit located to provide the path along the inclined side wall member and advantages thereof, including wherein such discharge unit is below the sample stage, and advantages thereof; and/or the other features of the present invention as in the dependent claims, as referred to previously, and advantages thereof.

The contention by the Examiner on, e.g., page 3 of the Office Action mailed November 25, 2003, that Collins, et al. discloses a vacuum pumping system 21 connected to a vacuum line 19 disposed at the bottom of the chamber, is noted. It is respectfully submitted, however, that such system as described in Collins, et al., would have neither disclosed nor would have suggested, and in fact would have taught away from, the structure according to the present invention including the discharge unit providing the recited path, and in particular the discharge unit as in claims 19-21. It is emphasized that in Collins, et al. the outlet is away from the side of the chamber, and would not form the recited path.

Similarly, reference by the Examiner to exhaust port 44 of Li, et al., disposed at the bottom of the chamber, is noted. It is respectfully submitted that this structure of Li, et al., at the bottom of the chamber and spaced from the side wall, either alone

or in combination with the teachings of the other applied references, would have neither disclosed nor would have suggested, and in fact would have taught away from, the structure of the present claims, having the discharge unit and wherein such unit provides the path as in the present claims.

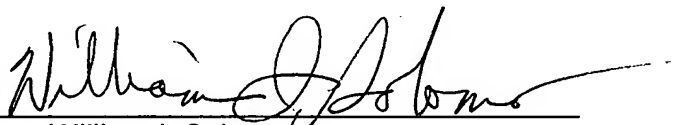
As recognized by the Examiner on page 12 of the Office Action mailed November 25, 2003, Lu, et al., does not even show a vacuum pumping system or discharge unit; and contrary to the contention by the Examiner, it is respectfully submitted that this patent does not describe a discharge unit. It is respectfully submitted that Lu, et al. is silent with respect to gas discharge, and even in combination with the teachings of the other applied references, would have neither disclosed nor would have suggested the discharge unit as in the present claims, and advantages thereof.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application, are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Antonelli, Terry, Stout & Kraus, LLP Deposit Account No. 01-2135 (Docket No. 520.38533VV5), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By 
William I. Solomon
Reg. No. 28,565

1300 North Seventeenth Street, Suite 1800
Arlington, Virginia 22209
Telephone: (703) 312-6600
Facsimile: (703) 312-6666
WIS/sjg